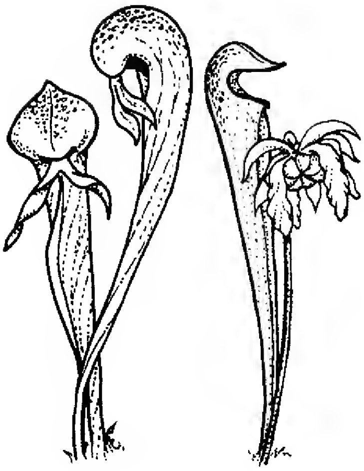
CARNIVOROUS PLANT NEWSLETTER

Journal of the International Carnivorous Plant Society

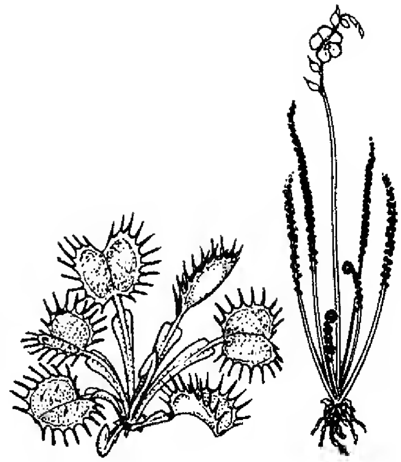
Volume 43, No. 3 September 2014



CARNIVOROUS PLANT NEWSLETTER

Journal of the International Carnivorous Plant Society
www.carnivorousplants.org

Volume 43, Number 3
September 2014



Front Cover: *Cephalotus follicularis* growing near the Donnelly River, Western Australia. Photo by Richard Nunn. Article on page 96.

Back Cover: *Pinguicula primuliflora* 'Rose'. Photo by Barry Rice. Article on page 103.

Carnivorous Plant Newsletter is dedicated to spreading knowledge and news related to carnivorous plants. Reader contributions are essential for this mission to be successful. Do not hesitate to contact the editors with information about your plants, conservation projects, field trips, or noteworthy events. Advertisers should contact the editors. Views expressed in this publication are those of the authors, not the editorial staff.

All correspondence regarding dues, address changes and missing issues should be sent to the Membership Coordinator at the ICPS. Do not send such correspondence to the editors. Checks for subscriptions should be made to the ICPS in US funds. Dues for 2014 are $35 for the first year of membership; renewals are $30 per year.

International Carnivorous Plant Society, Inc.
2121 N. California Blvd., Suite 290
Walnut Creek, CA 94596-7351, USA
icps@carnivorousplants.org

Date of effective publication of the June 2014 issue of Carnivorous Plant Newsletter: 2 June 2014.

The ICPS is the International Cultivar Registration Authority (ICRA) for the names of cultivated carnivorous plants according to the International Code of Nomenclature for Cultivated Plants. Send relevant correspondence to the ICPS, Inc.

Carnivorous Plant Newsletter is published quarterly in March, June, September, and December by the ICPS, Inc., 2121 N. California Blvd., Suite 290, Walnut Creek, CA 94596, USA. Periodicals postage paid at Richmond, CA and additional mailing offices. Postmaster: Send address changes to ICPS, Inc., 2121 N. California Blvd., Suite 290, Walnut Creek, CA 94596, USA. Printed by Allen Press, Inc., 810 E. 10th Street, Lawrence, KS 66044. Logo and masthead art: Paul Milauskas.

ISSN #0190-9215

Contents

Phill Mann 1951–2014

The carnivorous plant community sadly lost another long-time enthusiast. Phill Mann died on August 3, 2014 in Perth, Australia at the age of 63. A memorial to Phill will be in the December issue.

A new feature

Our readership ranges from world class scientists to the 9-year-old that just received (and perhaps killed) her first Venus Flytrap. We try to print papers of interest to this diverse readership. Some of the science papers can be a bit pointy-headed and leaves many of us wondering "so what?" Starting this month, we are including a synopsis of each paper that is intended to be the proverbial "elevator pitch" where the author must tell us the importance of their paper in that short time before the elevator doors open and the reader departs. We hope these will be useful.

Synopsis

Timothy Kennell, Jr., Chuck Robertson, and Michael S. Bodri: A reversible smoke-induced secondary dormancy in Venus Flytrap (*Dionaea muscipula*) seed

The late Bob Hanrahan approached one of us (MSB) and asked if I would try and help him to find an easy method that anyone could use to stimulate germination of Venus Flytrap (VFT) seed that had been stored at room temperature for a year or longer. We did a very simple experiment where we exposed groups of seed to known germination stimulants: moist chilling treatment for 4 weeks (stratification); scratching of the seed coat (scarification); immersion in hydrogen peroxide; immersion in hot water; and, exposure to smoke in the form of a commercially available liquid concentrate. The seeds used were freshly harvested or had been stored for a year or longer under different conditions. Fresh seed and seed stored in a refrigerator outperformed seeds stored at room temperature or stored under a combination of methods. We discovered that compared to our control groups, seeds exposed to full strength liquid smoke did not germinate. A thorough review of the scientific literature and subsequent experiments revealed two tantalizing facts about VFT seed – the seed is immediately viable and typically germinates within a span of a few days about 2 weeks upon release by the plant and, we could induce dormancy in fresh seed with diluted liquid smoke and then reverse that dormancy with hydrogen peroxide or stratification. Fresh seed placed into dormancy and the dormancy reversed subsequently germinated in numbers similar to controls but, their germination over time is very different, spread out over a 2-week time interval. We speculate that this is actually a survival strategy on the part of the plants. In their native habitat, summer wildfires will burn off competing vegetation that, while good for mature plants, is detrimental to new seedlings due to the low water table and desiccation from the sun. If dormancy is induced, the seed will overwinter to germinate in the spring since the natural stratification period eliminates the dormancy induced by the smoke. Germination over a longer time span in the spring helps to insure seedling survival if frosts kill the earliest germinating plants, but seeds that germinate later will be spared.

Richard Nunn: New insights into the growth cycle of *Cephalotus follicularis*

Proposes the following hypothesis of the *Cephalotus follicularis* growth cycle. After a fire *C. follicularis* grows quickly from its fleshy rhizome. Non-carnivorous leaves are produced and followed by carnivorous traps that capture as much prey as possible to store food in the rhizome, which grows quickly and produces new growth points. Profuse flowering occurs late in summer and seedlings develop that attain a reasonable size within a few seasons. As the plants get crowded out they start to produce only non-carnivorous leaves to capture the small amounts of light that get through the canopy of surrounding plants, and live off the stores of nutrients in their rhizomes. The plants exist in this semi-dormant state for up to 10 years or more until the next fire.

Matthew M. Kaelin: The sundew hybrid *Drosera* ×*beleziana* found on Long Island, New York

Drosera ×*beleziana* was recently discovered on Long Island, NY. Describes the hybrid's parent species and habitats, the characteristics that differentiate them from one another, and how to identify the hybrid. Lists other areas of the world where this hybrid has been observed, raises the question of why it has not been reported more often, and encourages readers to search for and report new locations of this hybrid.

Matthew M. Kaelin: The life and death of Arthur Dobbs

Discusses a visit to the grave of Arthur Dobbs and a brief history of who he was, his family and professional life, and a few of his accomplishments in natural history. Includes the story of how and why he made his way from Ireland to colonial North Carolina, his discovery of the Venus Flytrap, the scandalous romance of his later life, his death, and the legacy he left behind.

Bob Ziemer: *Pinguicula primuliflora* 'Rose'

Pinguicula primuliflora 'Rose' (Ban) is a variant or possibly hybrid that produces a beautiful double flower. Other than the unique flower, the plant looks identical to the typical *P. primuliflora*. Briefly discusses the plant and its history.

Koji Kondo: Double-flower of *P. primuliflora*

An English translation of Mitsuaki Ban's Japanese description of *Pinguicula primuliflora* 'Rose' that appeared in The Journal of Insectivorous Plant Society in October 2000.

Peter D'Amato and Matthew Hutley: New cultivars

Official descriptions of the new cultivars *Sarracenia* 'Randy Rable' and *Sarracenia* 'Laughing Wizard'.

A reversible smoke-induced secondary dormancy in Venus Flytrap (*Dionaea muscipula*) seed

Timothy Kennell, Jr. • NIH Medical Scientist Training Program (MD/PhD Program) • UAB The University of Alabama at Birmingham • Birmingham, Alabama 35294 • USA
Chuck Robertson • Department of Psychological Science • University of North Georgia • Dahlonega, Georgia 30597 • USA
Michael S. Bodri • Department of Biology • University of North Georgia • Dahlonega, Georgia 30597 • USA • MSBodri@ung.edu

Keywords: *Dionaea muscipula*, dormancy, germination, inhibition, seed, Venus Flytrap.

Abstract: The Venus Flytrap (VFT) is fire adapted because it regenerates vegetatively from its rhizome after seasonal fires. Many fire-adapted plants have seed that germinate following smoke exposure. Mature VFT seed are quiescent and germinate almost immediately when exposed to appropriate physical environmental factors. Here we show that smoke exposure induces secondary dormancy in VFT seed. Smoke-exposed seed exhibit either complete inhibition or significant delays of germination; however, the secondary dormancy can be reversed by soaking the seed in hydrogen peroxide solution or stratifying the seed. Whereas the treatment with peroxide resulted in germination comparable to controls, stratification resulted in germination over a prolonged time period. We propose induced dormancy demonstrates a unique fire adaptation as dormancy would prevent summer germination under adverse conditions following fire and stagger germination later in the fall or spring following winter stratification, allowing germination over a wider and more favorable range of environmental conditions.

Introduction

Historically, the Venus Flytrap (VFT) (*Dionaea muscipula*) was found associated with pocosin and longleaf pine semi-savannah of coastal North and South Carolina (Roberts & Oosting 1958). High quality longleaf pine (*Pinus palustris)* dominated habitats, and the herbaceous plants associated with them, require frequent low-intensity fires for population maintenance (Glitzenstein *et al.* 2001). The primary factors influencing the natural distribution of VFT were ascertained to be moisture and light intensity for localized populations, but overall distribution by soil type (Roberts & Oosting 1958), while fire is the dominant factor in maintaining populations (Gray *et al.* 2003). Although VFT evolved under a high-frequency fire regimen (Roberts & Oosting 1958), during fire-free periods plants are able to persist in a dormant state underground for an unknown period of time (Luken 2005). Highest flowering and seedling establishment occurs after fire although seedling survivorship is negatively impacted due to increased desiccation risk (Luken 2007).

While this plant has fascinated naturalists since its description in the mid-1700's, most studies concerning it have dealt with its carnivorous nature and the trapping mechanism of the modified leaves as well as the effect of varying fire regimens on VFT abundance, while few have dealt with demography. Studies specifically investigating VFT seed are virtually non-existent and the few studies that have been published, two of which are dated, address germination of the seed indirectly by investigating habitat and common environmental cues known to cause germination (Roberts

& Oosting 1958; Luken 2005; Smith 1931). The latter two studies did note the importance of fire in VFT habitat. Roberts and Oosting (1958) speculated that fire served as a means of eliminating competing vegetation; however, a later study (Luken 2007) found that simply removing competing vegetation did not enhance plant growth or new germination.

Observations reported in the popular press regarding VFT ecology may be contrary to those reported in peer-reviewed literature. One example is the supposition that VFT form seed banks (McPherson 2010). Short-lived species of carnivorous plants such as some *Drosera* and *Utricularia* may escape competition during fire-free intervals by the production of a persistent seed bank (Brewer 2001). Even though it is well known that seed viability diminishes over time (Schnell 2002), recent works still support the idea that seed banks develop from viable seed that remain dormant in the soil (Bailey & McPherson 2012).

Because it was not known if seed of VFT can accumulate in a persistent seed bank, we wished to investigate this possibility and whether they required any specific cues, particularly fire-related, to stimulate germination. As such, fresh seed and seed stored under a variety of conditions were exposed to different treatments under laboratory conditions. Treatments included stratification (6 weeks of exposure to moisture and cold [4°C] in the dark), soaking in hydrogen peroxide (H_2O_2), liquid smoke, hot water, and scarification.

Materials and Methods

Four cohorts of 1200-1500 seeds were used for our initial experimental protocol. Cohorts were based upon storage conditions: Cohort 1, comprised of seed collected June 2009 and immediately stored at 4°C until use within a few months (Fresh); Cohort 2, comprised of seed collected June 2008 and stored approximately 14 months at 4°C prior to use (Cold); Cohort 3, comprised of seed collected June 2008 and stored approximately 14 months at room temperature prior to use (Warm); and, Cohort 4, comprised of seed collected June 2008 stored at room temperature for approximately 13 months and then 4°C cold storage for 1 month (Warm/Cold). Subsequent experiments used freshly collected seed (July 2010) and 1-year-old seed that was stored at 4°C.

Seed from all 4 cohorts were subjected to up to 7 treatments prior to sowing (n=200 seeds/treatment) with direct sowing serving as a control. Sowing was done by scattering treatment groups between sheets of ddH_2O moistened Whatman #1 filter paper in 150 mm glass Petri dishes that were then sealed in clear plastic bags. All bags were placed in a Percival controlled environment chamber (Perry, IO) maintained at 25°C with a 14:10 L:D cycle under 155 μmoles/m^2/sec illumination.

There are several common methods for breaking dormancy of seeds that have been well researched. Fire-stimulated germination of seed has been postulated to include dry heat fracturing of the seed coat, stimulation of the embryo by dry heat, desiccation of the seed coat, and stimulation of germination by compounds found in the smoke (Brown 1993).

Another treatment that influences seed dormancy is cold stratification (moist chilling). Common cold stratification consists of keeping the seeds moist at low temperatures, generally 0-15°C. Ross (1984) and later Lewak *et al.* (2000) suggests that cold stratification initiates processes that allow the seed to utilize its nutrient storage. One of the first compounds broken down in stratification is phytic acid, which is stored as organic phosphates to be used as energy during germination (Andriotis *et al.* 2005). Eventually, cold stratification triggers proteins to break down into amino acids (Einali & Sadeghipour 2007). The amino acids are then utilized in construction of proteins used for germination (Rajjou *et al.* 2004).

Mechanical scarification breaks physical dormancy of seeds by weakening or fracturing the seed coat (Baskin & Baskin 2004), allowing the seed to imbibe water from the environment to serve

in germination (Pérez-Garcia & González-Benito 2006). Mechanical scarification may also aid in increasing oxygen uptake by the seed (Stabell *et al.* 1998). The effect of scarification is considered comparable to the cracks caused by extreme heat due to fire exposure (Herranz *et al.* 1998).

A modification of mechanical scarification is soaking seed in hot water. This treatment is commonly used in plants that have physical dormancy in which the seed coat hinders the entry of water. Turner *et al.* (2005) demonstrated that hot water could be an effective means of increasing the water absorption of several genera of *Rhamnaceae*. Most suggested mechanisms involve an anatomical change in the seed coat. For various species in the genus *Acacia*, hot water cracks the seed coat to allow water entry (Brown & Booysen 1969). In other plants, the anatomical change is a single crack near the emergence point of the radical caused by a small swelling at this location (Li *et al.* 1999). In both instances, the water-impermeable seed coat is broken to allow entry of water.

Recent studies suggest that H_2O_2 can stimulate germination. The mode of action was originally thought to be its disinfectant properties. Joseph *et al.* (1998) demonstrated that H_2O_2 limits the growth and proliferation of two species of the plant pathogenic fungus *Pseudocercospera* at very low concentrations. While limiting fungal growth would benefit the plant, the actual germination would not be stimulated by the H_2O_2.

Germination-inducing treatments consisted of 6 weeks of stratification; 24-hour soaking in hydrogen peroxide (1:2 v:v dilution of commercial strength solution in water) or liquid smoke (commercial food grade liquid smoke product [TRYME®Liquid Smoke, Reily Foods Company, New Orleans, LA] used at full strength or diluted 1:9 v:v in water); boiling water immersion; scarification; or direct sowing. The hot water treatment consisted of adding seeds to ddH_2O that been brought to a boil and allowed to cool until cessation of boiling. Seed were then added and left in the water as it cooled to room temperature for 24 hours. Scarification was performed on the day all other treatment seed were sown by placing seed into a 50 ml centrifuge tube with 5 ml of coarse sand. The tube was vigorously shaken for 5 minutes and the seed dispensed to a Petri dish as described. Some treatments were combined: exposure to smoke followed by exposure to H_2O_2 or followed by stratification. Germination was typically evaluated on a daily basis for 3 weeks after the first day of germination.

Log-linear analysis assessed the distribution of data from the cohort study by testing interactions of cohort, treatment, and germination. Hypothesis testing of partial independence and of conditional independence was performed following repeat analysis by means of a three-dimensional contingency table. Chi-square of contingency was utilized to compare treatment germination results within and between cohorts.

Replicate sowing data were analyzed by one-way ANOVA of seed treatment and age ($p=0.000$). Student Newman-Keuls was utilized as a post hoc ($p=0.05$).

An estimation of germination speed is given by /50 which indicates the time in which 50% of final germination was achieved (t^{50}). An ANOVA compared t^{50} values ($p=0.000$). A subsequent Games-Howell post hoc test was used to find homogenous groups within means. Differences between the treatments were considered significant at $p=0.05$.

The logrank test was used to compare distributions for the treatment effect. Kaplan-Meier curves were generated for the data to measure germination rate, using germination as the event of interest.

Results

Initial experiments examined storage conditions (cohort) and known germination inducers (treatment) on germination success. A three-way (cohort × treatment × germination) log-linear

Table 1. Log-linear analysis of known germination stimulants applied to *Dionaea muscipula* seed. Values represent percent (%) germination.

	Warm/Cold(%)	Cold (%)	Warm (%)	Fresh (%)
Liquid Smoke	0.00%^{a}	0.00%^{a}	0.00%^{a}	0.00%^{a}
Liquid Smoke, Dilute	N/A	68.50%$^{a, f}$	N/A	71.00%$^{a, f}$
Scarification	13.00%$^{a, b, A}$	54.00%$^{a, b, f, A, B}$	22.00%$^{a, b, A, B, C}$	74.50%$^{a, b, A, B, C}$
Stratification	17.50%$^{a, c, A}$	57.00%$^{a, c, f, A, B}$	6.00%$^{a, b, c, A, B, C}$	0.00%$^{b, c, f, A, B, C}$
Hydrogen Peroxide	33.50%$^{a, b, c, d, A}$	71.50%$^{a, b, c, A, B}$	20.00%$^{a, A, B, C}$	59.00%$^{a, b, c, d, f, A, B, C}$
Hot Water	21.50%$^{a, b, d, e, A}$	64.50%$^{a, b, A, B}$	16.00%$^{a, c, A, B, C}$	38.50%$^{a, b, c, d, f, A, B, C}$
Control	12.50%$^{a, d, e, A}$	68.50%$^{a, b, c, A, B}$	16.50%$^{a, c, B, C}$	41.50%$^{a, b, c, d, f, A, B, C}$

Treatments (n=200) were applied to four different cohorts of seeds: warm/cold, cold, warm and fresh. Treatments and cohorts were tested for significance by pair-wise comparison using a two-dimensional Chi-Square of Contingency. Lowercase superscript letters indicate statistical differences between treatments within cohorts. Uppercase letters indicate statistical differences between cohorts within treatments. The treatment or cohort that was used for a set of pair-wise comparisons is indicated as follows: a=Liquid Smoke, b=Scarification, c=Stratification, d=Hydrogen Peroxide, e=Hot Water, f=Liquid Smoke, Dilute, A=Warm/Cold, B=Cold, C=Warm.

analysis produced a final model that retained all effects, that there is significant interaction among all three variables in the population sampled. The likelihood ratio of this model was $X^2(0)=0$, $p=1$. This indicated that the highest order interaction (cohort × treatment × germination) was significant, $X^2(8)=39.18$, $p<0.001$. Analysis for partial independence of the cohorts determined that dependencies exist between all three variables. There was a significant association between the type of seed treatment and whether or not germination occurred. The results of subsequent Chi-square of contingency analysis of treatments within and between cohorts are presented in Table 1, and indicate significant pair wise differences between cohorts and between treatments within cohorts.

With two exceptions germination occurred in all treatments across all cohorts. One stratification treatment had no germination likely due to fungal contamination. All seed treated with full strength liquid smoke had complete germination failure. Across cohorts, all stratification treatments differed significantly, as was true for scarified, H_2O_2 and hot water exposed seed. Old seed stored at room temperature with or without a subsequent cold storage period had similar levels of germination that were significantly less than refrigerated or fresh seed, likely due to decreased viability. Within cohorts, seeds that had been stored refrigerated or at room temperature and then stratified germinated at a significantly reduced level versus controls. Fresh seed that had been scarified had improved germination than controls, possibly due to damage to the heavy walled outer seed coat and subsequent faster imbibition of water. H_2O_2 increases germination of fresh seed while hot water does not.

Across cohorts we observed obvious discrepancies in regards to germination success leading us to conclude that treatments were not breaking dormancy and that aged seed had, in fact, lost viability.

Because of the interactions noted from the cohort study and the observation during data collection that germination seemed to be occurring at different rates depending upon treatment, we ran new germination studies with replicates to allow for more in-depth analysis. ANOVA and post hoc analysis of replicated treatments (Table 2) confirmed that liquid smoke, an aqueous condensate of pyrolysis products released from controlled wood burning in the absence of air (Kim *et al.* 2011),

Table 2. Mean comparison of treatments of seeds with known germination stimulants using an ANOVA. Values are expressed as percent (%) germination.

	Mean +/- Standard Deviation (%)	
Treatment	Stored Seed	Fresh Seed
Liquid Smoke	$26.0\pm17.4\%^{a}$	$35.0\pm12.8\%^{a}$
Liquid Smoke/H_2O_2	$25.0\pm7.6\%^{a}$	$86.0\pm5.2\%^{b}$
Liquid Smoke, Dilute	$35.0\pm16.8\%^{a}$	$84.0\pm9.8\%^{b}$
Control	$73.0\pm13.6\%^{b}$	$92.0\pm3.3\%^{b}$
Stratified	$74.0\pm18.6\%^{b}$	$86.0\pm8.3\%^{b}$
H_2O_2	$77.0\pm8.9\%^{b}$	$96.0\pm5.7\%^{b}$
Liquid Smoke, Dilute/Stratification	–	$85.0\pm10.0\%^{b}$
Liquid Smoke, Dilute/H_2O_2	–	$88.0\pm21.4\%^{b}$

Stored seed was kept at room temperature for 14 months while fresh seed was utilized within 1 month of harvest. Each treatment is an average of 4 replicates (n=25). Treatments with forward slash (/) are combination treatments in which the seed was first treated with smoke and then treated with the second stimulus. Lowercase superscripts on means indicate significance groups based on a Student Newman-Keuls. Means in the same group are statistically different from means in the other group.

had an effect on germination. All seeds exposed to undiluted liquid smoke (hereinafter referred to as smoke) had significantly reduced final germination compared to all other treatments. While we anticipated smoke treated seed to have reduced viability based upon the cohort study, we were surprised to find that fresh seed was actually inhibited from germinating and not killed. Subsequent treatment of smoke exposed seed with stratification or H_2O_2 restored final germination to that of controls. Smoke apparently induces a secondary dormancy in fresh VFT seed.

As the post hoc analysis only examines final germination success to determine significance between treatments and ignores the rate of germination and germination time interval (Fig. 1), we analyzed germination speed (Fig. 2). Figure 1 illustrates how the rate of germination of the seed allowed us to appreciate that the different treatments do have an effect on germination not accounted for if only examining final germination results. Germination of fresh seed is extremely rapid, with almost 100% of viable seed germinating over 2 days, while smoke treated seed takes longer before initial germination and furthermore germination is prolonged over a longer duration of time. This inhibition of germination is reversed with either stratification or H_2O_2 treatment. Analysis of these rates by calculating a line of best fit and determining the slope is not possible because a straight line does not provide an accurate description of rate due to the unusual germination pattern of the seed.

The daily germination of seed over time (Fig. 2) graphically represents how smoke inhibits seed from immediate germination versus the rapid germination observed in the control. The few seeds that do germinate when exposed to smoke begin later and over a much longer period of time, with only 1 or 2 seeds germinating daily. Seeds inhibited by smoke and then treated by stratification or H_2O_2 show reversed dormancy. These seed begin to germinate around the same time as controls however their daily germination totals are lower than controls while the interval over which they germinate is prolonged.

Germination rates of control and dormancy reversed seed differ significantly from smoke inhibited seed (Fig. 3). Box and whisker plots do not account for censored data and the time to 50% germination can be identical for treatments that have differing germination rates and

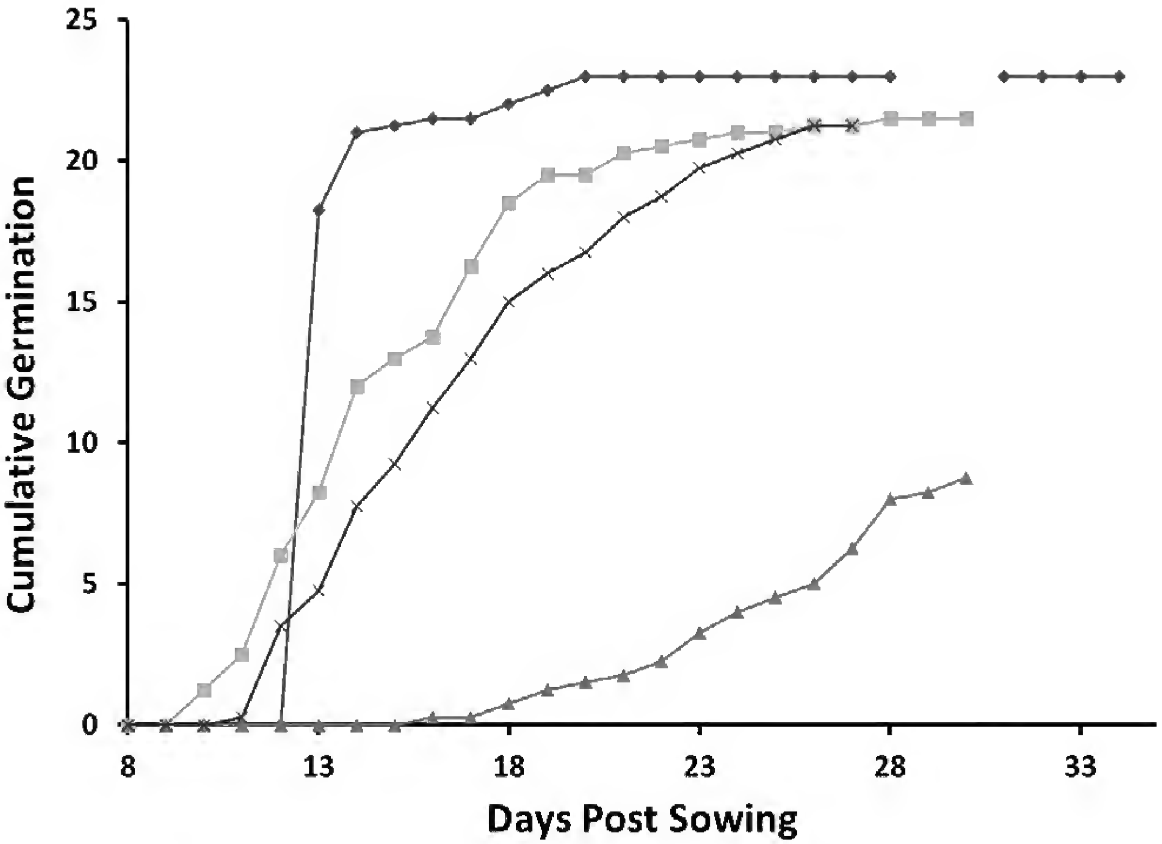


Figure 1: Effects of selected treatments on the rate of *Dionaea muscipula* seed germination. Each treatment is an average of 4 replicates (n=25). All germination studies for the selected treatments were conducted using immediately viable seed. Treatments with a forward slash (/) are combination treatments in which the seed was first treated with smoke and then treated with the second stimulus. Selected treatments are Control (—◆—), Liquid Smoke (—▲—), Liquid Smoke/H_2O_2 (—■—), and Liquid Smoke, Diluted/Stratification (—✕—). The graphical representation of *D. muscipula* seed over time indicates that liquid smoke creates a secondary dormancy that is reversed by H_2O_2 and stratification.

significantly different total germination means. In addition, because 100% of the seed did not germinate for the control group or any of the treatment groups within the timeframe for monitoring germination, censored data (waiting time) resulted. To illustrate these differences, a Kaplan-Meier curve was constructed to show germination times for control, germination-inhibited seed induced by smoke treatment, and smoked-treated seed that was then treated with H_2O_2 or stratification to reverse the inhibition (Fig. 4). Here, the event of interest is germination. The germination curve for seeds inhibited with smoke is higher than the curves for the control and dormancy-reversed seed. Inhibition of germination is greater for the higher curve because the proportion of seeds that have not germinated is larger for this curve than for the lower curves at each time point. Similarly and more importantly, seed that was stratified to reverse smoke-induced inhibition took significantly longer than H_2O_2-treated seed to germinate (p=0.02) and H_2O_2-treated seed took significantly longer than the control (p=0.01). Kaplan-Meier graphing can illustrate trends that allows for discrimination among germination rates. From this we can resolve the discrepancy between scientific observations that no seed bank for VFT exists (immediate germination of ripe seed) and observations that suggest otherwise, such as a flush of germination following fire.

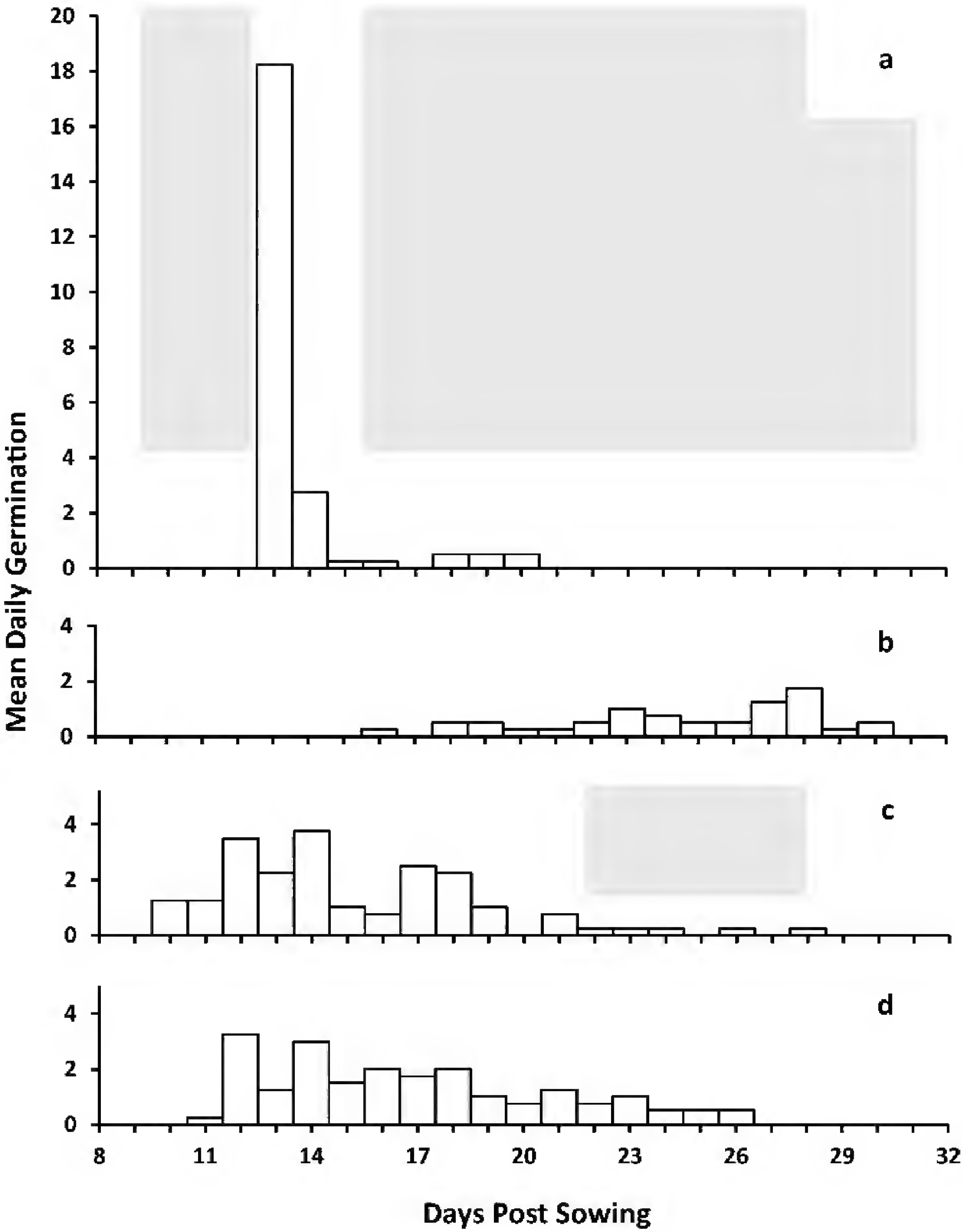


Figure 2: Treatment effect on daily germination of immediately viable *Dionaea muscipula* seed. Daily germination is the average of four replicates (n=25) for each treatment. The control treatment (a) indicates that *D. muscipula* seeds are immediately viable as shown by a large quantity of seeds germinating in a short period of time. Liquid Smoke (b) causes a secondary induced dormancy in seed indicated by few seeds germinating. Both combination treatments, Liquid Smoke/H_2O_2 (c) and Liquid Smoke, Diluted/Stratification (d) indicate a reversal of dormancy due to most of the seeds within the treatment germinating.

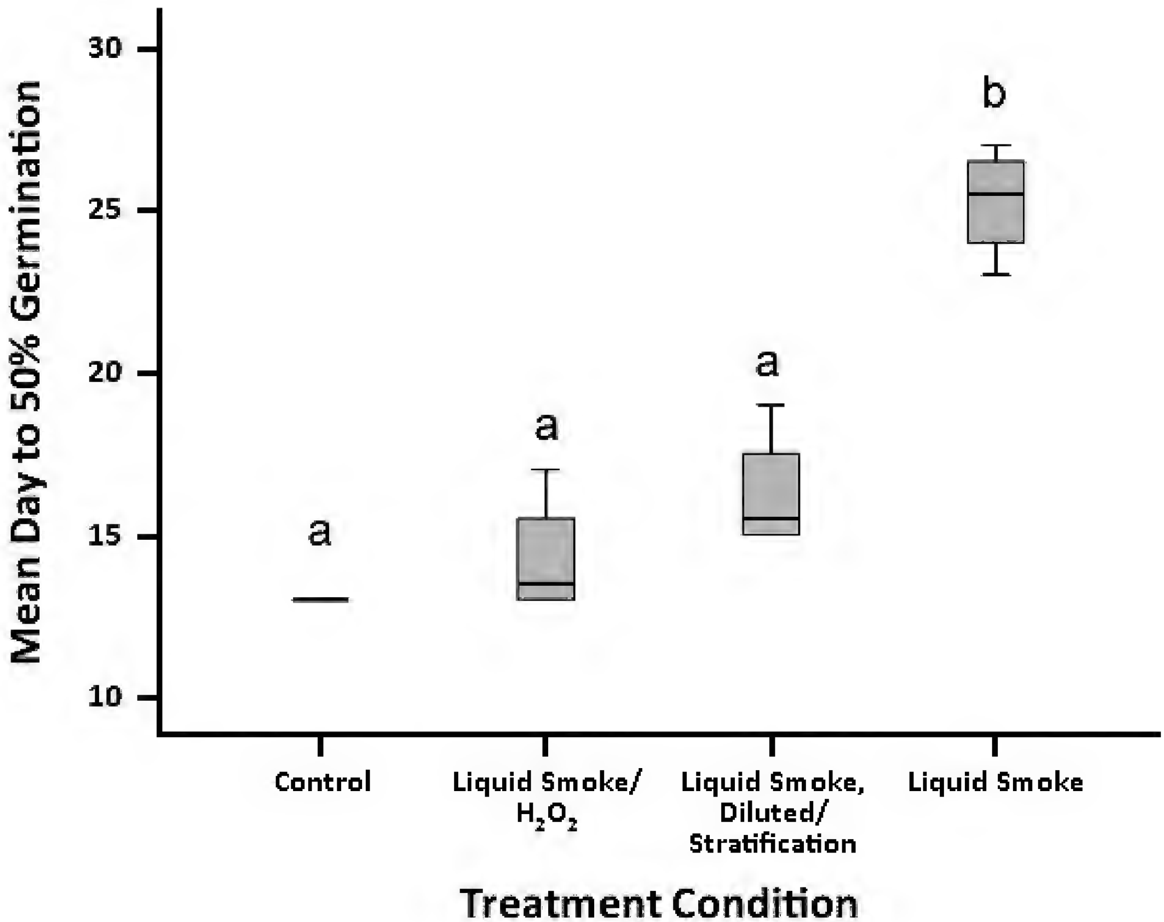


Figure 3: Analysis of germination rate of immediately viable *Dionaea muscipula* seed using time to fifty percent of total germination (t^{50}). For each plot, the box represents the interquartile range (25th to 75th percentile), the horizontal line within the box represents the median, and the bars represent the maximum and minimum distribution of the data. The t^{50} values were analyzed using an ANOVA to determine differences among treatments followed by a Games-Howell post hoc. Each treatment is an average of 4 replicates (n=25). Treatments with different letters are significantly different. Reversal of the inhibition of germination rate is reversed by either H_2O_2 or stratification.

Discussion

Studies have linked the chemical activity of smoke components to that of endogenous hormones in plants (van Staden *et al.* 2000). Todorović *et al.* (2005) demonstrated that when liquid smoke was applied to seeds of *Paulownia tomentosa* along with gibberellins, the hormones effectiveness was significantly increased. Actual components of smoke that elicit germination have been difficult to determine since smoke is composed of many different chemicals, some of which cause seed death if the concentration is too high (Nelson *et al.* 2009). Recently, 3-methyl-2*H*-furo[2,3-*c*]pyran-2-one and analogous butenolide molecules designated as karrikins have been extracted from smoke and shown to provide germination cues for seeds (Nelson *et al.* 2009; van Staden *et al.* 2000).

Neill *et al.* (2002) suggests that H_2O_2 works as a signaling molecule, performing different functions in relation to concentration as demonstrated by Vandenabeele *et al.* (2003), with low *in planta* levels up-regulating genes (mostly associated with adverse environmental conditions) and high levels inducing programmed cell death. Dolatabadian and Modarres Sanavy (2008) showed that H_2O_2

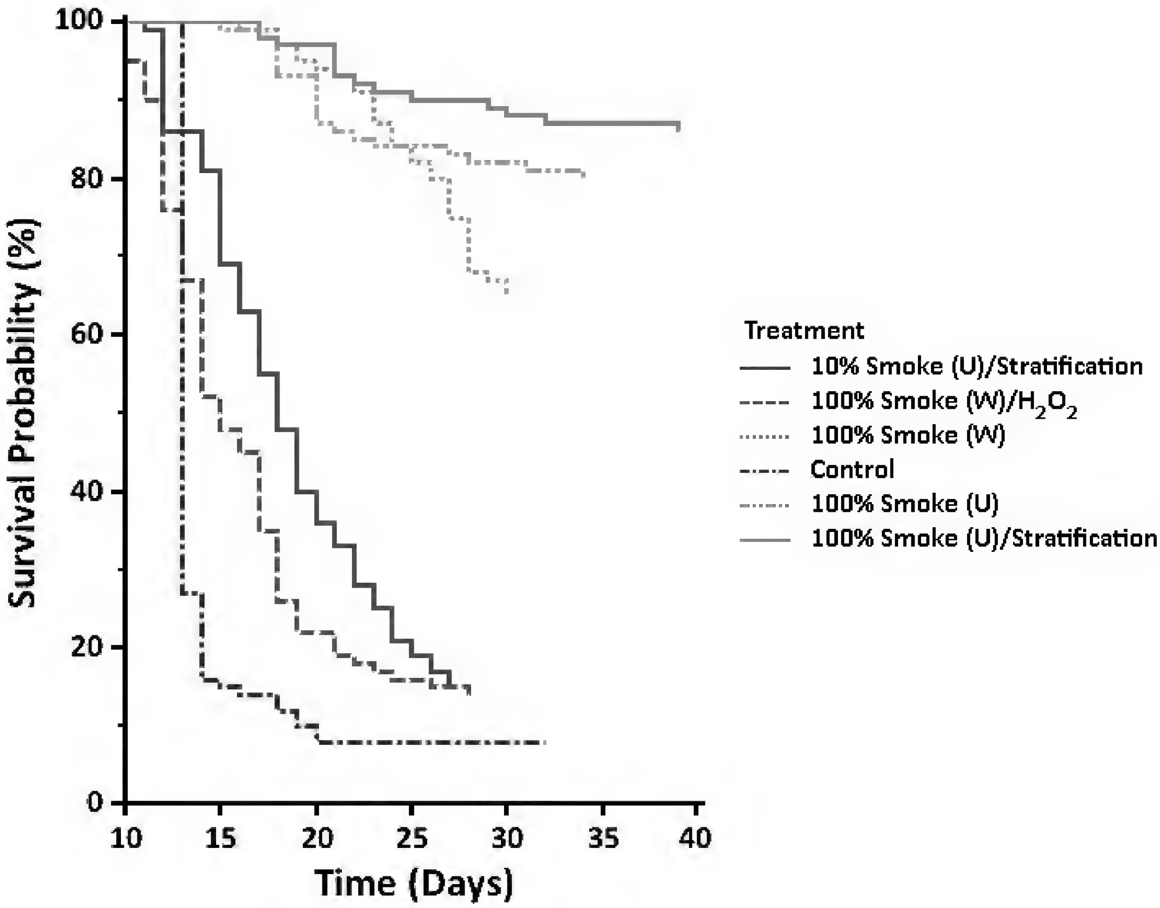


Figure 4: Kaplan Meier estimate of germination rate of immediately viable *Dionaea muscipula* seed. Each treatment is an average of 4 replicates (n=25). The germination probability is the likelihood of seed in the given treatment group not germinating. This probability can be interpreted to be a rate by analyzing change in germination probability over time. Survival curves were tested pairwise for statistical significance using a Chi-square goodness of fit test with $\alpha = 0.05$ for all tests. A "W" or "U" following the treatment description indicates the seeds were briefly washed (W) or unwashed (U) with distilled water following treatment.

positively influenced sunflower, rape, and safflower germination at lower concentrations (1 and 3%) due to germination inhibitor oxidation.

Because of the ability to germinate immediately upon ripening, seed of VFT do not accumulate in a persistent seed bank but may form a temporary seed bank. VFT seed, even though released from the plant in a non-dormant state, can be induced into a secondary dormancy by exposure to smoke from summer fires. In this manner, it is somewhat similar to "dormancy cycling" of some temperate annual species (Chen *et al.* 2011; Schütz 1998), preventing immediate germination during a favorable season of the year but under environmental conditions that are not favorable for seedling survival (Hilhorst *et al.* 2010; Luken 2007). As fire-free intervals may be critical for seedling survival and growth (Luken 2007), VFT seed exposed to smoke avoid germination and therefore a greater death risk from high temperatures and increased likelihood of desiccation. Germination will then occur later in the fall or the following spring after a period of moist stratification eliminates inhibiting substances from the seed (Light *et al.* 2002). Subsequent germination is spread over a much longer time interval than non-dormant seed. This prevents losses of seedlings that may have

germinated *en mass* during short periods of favorable conditions in the fall or spring, only to be killed by late or early frosts, respectively. Seeds that escape killing frosts would benefit from the increased light resulting from the fire-modified habitat as well as from the higher water table and increased rainfall, advantages not available during summer germination. Further investigation is warranted to determine if liquid smoke can be used to extend the viability of short-lived seed of agricultural importance.

Acknowledgements: MSB thanks Robert Hanrahan (deceased) for asking him to investigate VFT seed germination and for providing the initial batch of seed used for the cohort study.

References

Andriotis, V.M.E., Smith, S.B., and Ross, J.D. 2005. Phytic acid mobilization is an early response to chilling of the embryonic axes from dormant oilseed of hazel (*Corylus avellana*). J. Exp. Bot. 56: 537-545.

Bailey, T., and McPherson, S. 2012. *Dionaea*. The Venus's Flytrap. Redfern Natural History Productions, Dorset. 448 p.

Baskin, J.M., and Baskin, C.C. 2004. A classification system for seed dormancy. Seed Science Research 14: 1-16.

Brewer, J.S. 2001. A demographic analysis of fire-stimulated seedling establishment of *Sarracenia alata* (Sarraceniaceae). Am. J. Bot. 88: 1250-1257.

Brown, N.A.C. 1993. Promotion of germination of Fynbos seeds by plant-derived smoke. New Phytol. 123: 575-583.

Brown, N.A.C., and Booysen, P. 1969. Seed coat impermeability in several *Acacia* species. Agroplantae 1: 51-60.

Chen, F., Martin, R.C., Song, S., and Nonogaki, H. 2011. Seed development and germination. In: Trigiano, R.N., and Gray, D.J., editors. Plant Tissue Culture, Development, and Biotechnology. CRC Press, Boca Raton. pp. 127-140.

Dolatabadian, A., and Modarres Sanavy, S.A.M. 2008. Effect of the ascorbic acid, pyridoxine and hydrogen peroxide treatments on germination, catalase activity, protein and malondialdehyde content of three oil seeds. Not. Bot. Hort. Agrobot. Cluj. 36: 61-66.

Einali, A.R., and Sadeghipour, H.R. 2007. Alleviation of dormancy in walnut kernels by moist chilling is independent from storage protein mobilization. Tree Physiol. 27: 519-525.

Glitzenstein, F.S., Streng, D.R., Wade, D.D., and Brubaker, J. 2001. Starting new populations of longleaf pine ground-layer plants in the outer coastal plain of South Carolina, USA. Natural Areas J. 21: 89-110.

Gray, J.B., Wentworth, T.R., and Brownie, C. 2003. Extinction, colonization, and persistence of rare vascular flora in the longleaf pine-wiregrass ecosystem: Responses to fire frequency and population size. Natural Areas J. 23: 210-219.

Herranz, J.M., Ferrandis, P., and Martínez-Sánchez, J.J. 1998. Influence of heat on seed germination of seven Mediterranean *Leguminosae* species. Plant Ecol. 136: 95-103.

Hilhorst, H., Finch-Savage, W., Buitink, J., Bolingue, W., and Leubner-Metzger, G. 2010. Dormancy in plant seeds. In: Lubzens, E., Cerda, J., and Clark, M., editors. Dormancy and Resistance in Harsh Environments. Topics in Current Genetics 21: 43-67.

Joseph, L.M., Tan, T.K., and Wong, S.M. 1998. Antifungal effect of hydrogen peroxide and peroxidase of spore germination and mycelial growth of *Pseudocercospora* species. Can. J. Bot. 76: 2119–2124.

Kim, S.P., Yang, J.Y., Kang, M.Y., Park, J.C., Nam, S.H., *et al.* 2011. Composition of liquid rice hull smoke and anti-inflammatory effects in mice. J. Agric. Food Chem. 59: 4570-4581.

Lewak, S., Bogatek, R., and Zarska-Maciejewska, B. 2000. Sugar metabolism in apple embryos. In: Viemont, J.D., and Crabbe, J., editors. Dormancy in Plants: From Whole Plant Behaviour to Cellular Control. CAB International, Wallingford, U.K. pp. 47-56.

Li, X., Baskin, J.M., and Baskin, C.C. 1999. Physiological dormancy and germination requirements of seeds of several North American *Rhus* species (Anacardiaceae). Seed Science Research 9: 237-245.

Light, M.E., Gardner, M.J., Jäge, A.K., and van Staden, J. 2002. Dual regulation of seed germination by smoke solutions. Plant Growth Regul. 37: 135-141.

Luken, J.O. 2005. *Dionaea muscipula* (Venus flytrap) establishment, release, and response of associated species in mowed patches on the rims of Carolina bays. Restoration Ecol. 13: 678-684.

Luken, J.O. 2007. Performance of *Dionaea muscipula* as influenced by developing vegetation. J. Torrey Bot. Soc. 134: 45-52.

McPherson, S. 2010. Carnivorous Plants and Their Habitats. Vol 1. Redfern Natural History Productions, Dorset. 723 p.

Neill, S.J., Desikan, R., and Clarke, A. 2002. Hydrogen peroxide and nitric oxide as signaling molecules in plants. J. Exp. Bot. 53: 1237-1242.

Nelson, D.C., Riseborough, J.A., Flematti, G.R., Stevens, J., Ghisalberti, E.L., *et al.* 2009. Karrikins discovered in smoke trigger *Arabidopsis* seed germination by a mechanism requiring gibberellic acid synthesis and light. Plant Physiol. 149: 863-873.

Pérez-García, F., and González-Benito, M.E. 2006. Seed germination of five *Helianthemum* species: Effect of temperature and presowing treatments. J. Arid Environments 65: 688-693.

Rajjou, L., Gallardo, K., Debeaujon, I., Vandekerckhove, J., Job, C., *et al.* 2004. The effect of alpha-amanitin on the *Arabidopsis* seed proteome highlights the distinct roles of stored and neosynthesized mRNAs during germination. Plant Physiol. 134: 1598-1613.

Roberts, P.R., and Oosting, H.J. 1958. Responses of Venus fly trap (*Dionaea muscipula*) to factors involved in its endemism. Ecol. Monographs 28: 193-218.

Ross, J.D. 1984. Metabolic aspects of dormancy. In: Murray, D.R., editor. Seed Physiology. Vol. 2. Germination and Reserve Mobilization. Academic Press, San Diego. pp. 45-75.

Schnell, D.E. 2002. Carnivorous Plants of the United States and Canada. 2nd ed. Timber Press, Portland. 468 p.

Schütz, W. 1998. Seed dormancy cycles and germination phenologies in sedges (*Carex*) from various habitats. Wetlands 18: 288-297.

Smith, C.M. 1931. Development of *Dionaea muscipula* II. Germination of seed and development of seedling to maturity. Bot. Gaz. 91: 377-394.

Stabell, E., Upadhyaya, M.K., and Ellis, B.E. 1998. Role of seed coat in regulation of seed dormancy in houndstongue (*Cynoglossum officinale*). Weed Science 46: 344-350.

Todorović, S., Giba, Z., Zivkovic, S., Grubisic, D., and Konjevic, R. 2005. Stimulation of empress tree seed germination by liquid smoke. Plant Growth Regul. 47: 141-148.

Turner, S.R., Merritt, D.J., Baskin, C.C., Dixon, K.W., and Baskin, J.M. 2005. Physical dormancy in seeds of six genera of Australian Rhamnaceae. Seed Science Research 15: 51-58.

Vandenabeele, S., Van Der Kelen, K., Dat, J., Gadjev, I., Boonefaes, T., *et al.* 2003 A comprehensive analysis of hydrogen peroxide-induced gene expression in tobacco. PNAS 100: 16113-16118.

van Staden, J., Brown, N.A.C., Jäger, A.K., and Johnson, T.A. 2000. Smoke as a germination cue. Plant Species Biol. 15: 176-178.

New insights into the growth cycle of *Cephalotus follicularis*

Richard Nunn • Singapore • Richardjnunn1@gmail.com

Introduction

Much of the literature on *Cephalotus follicularis*, particularly that focused on cultivation, is short on detail of the plant's true growth cycle. This is probably a result of observations in the field being limited to a single visit or observations being made of cultivated plants. Having made numerous visits to many *C. follicularis* swamps over the past 10 years, I began to notice some interesting trends starting to appear. In fact the *C. follicularis* true growth cycle may be much longer than first thought, and the state of the plants in full growth with carnivorous pitchers, may be not the norm in most habitats.

The Current Accepted Understanding

A recurring annual growth cycle, where *C. follicularis* puts out flat non-carnivorous leaves in spring, as the weather improves and daylight hours increase, are followed by carnivorous pitchers that last for as long as 12 months. Flowering occurs in late summer, and then as winter approaches and daylight hours and temperatures decrease, growth slows to the point where the plants are dormant.

A New Hypothesis Based on Observations in the Field

Bushfires are a natural part of the Australian bush and most *C. follicularis* swamps go through a cycle of growth that sees a major bush fire every 10-15 years, in some cases longer. Some swamps are also subject to controlled burns at shorter intervals. After the fire, the low-lying vegetation and grasses are completely burnt back and this exposes large areas of peat that receive constant moisture from underground seeps/springs. At this time *C. follicularis* recovers quickly from the fire and puts out many flat non-carnivorous leaves followed by pitchers. It is usually a year or two after the fire that most observations of *C. follicularis* occur. The interesting thing is that over a 3-5-year period the swamp completely regrows and the *C. follicularis* are completely crowded out. One particular swamp at Walpole in the D'entrecatsreaux National Park has now been observed since 2003. The swamp had been burnt out during 2002, visits in October 2003 and March 2005 (Fig. 1 left) yielded some excellent *C. follicularis*, *Drosera binata*, *Drosera hamiltonii*, and *Utricularia paulineae*. A further visit in November 2007, and the swamp had completely overgrown to the point where it was nearly impossible to see one's feet and in some places the tea trees were over 2 meters tall (Fig. 1 right). Extensive searches yielded no *C. follicularis*, yet there is no doubt they were there.

This process also occurred at a swamp in Denbarker that had been burnt out in 2004. The author and Phill Mann made visits in December 2005 (Figs. 2-3), March (Fig. 3) and October 2006, November 2007, and October 2008, by which time the swamp had regenerated and was now completely overgrown. Where there were once carpets of *C. follicularis,* there were now only a few patches of green non-carnivorous leaves growing in full shade. This swamp was then subject to a controlled burn in 2011, and a few months later in the burnt open patches the *C. follicularis* shoots were numerous and rapidly taking hold.

Figure 1: Left: The author photographing *Cephalotus follicularis* at a swamp in the D'entrecatsreaux National Park. This swamp had been burnt a few seasons before and the vegetation had not fully recovered.
Right: The same swamp 5 years after the burn. Phill Mann can just be seen through the dense regrowth.

Figure 2: A swamp at Denbarker 12 months after a burn. The vegetation is still relatively open. *Cephalotus follicularis* forming large clumps in the exposed areas after the fire.

Figure 3: Left: In the lower parts of the swamp, high levels of light and pools of water being fed from below provide ideal conditions for this impressive clump of *Cephalotus follicularis*.
Right: Eighteen months after the burn at Denbarker the surrounding plants are regenerating and growing amongst the *Cephalotus follicularis*.

Figure 4: Left: *Cephalotus follicularis* growing at Coalmine Beach attain very attractive coloration due to the constant exposure to bright light and open growing conditions; Right: plants growing in almost pure sand at Northcliffe.

A very recent visit (March 2014) to a site on the Pemberton – Northcliffe Rd., with Phill Mann and Allen Lowrie, seemed to confirm similar behavior. This swamp was very overgrown and in need of a controlled burn, a fire track had been cleared right through the middle of the swamp, and along the edges of the track, plants of *C. follicularis* with many traps were beginning to form. Attempts to find more plants by pushing through the dense bush just a meter off the cleared track, yielded nothing.

The question is what happens to *C. follicularis*, after a few years of growing in open areas, and then eventually becoming completely crowded out? They must still be there, as the new growth and size of the plants after a fire are not from seed. So here is an hypothesis, based on extensive observation, as to what might happen:

- After a fire *C. follicularis* grows quickly from its fleshy rhizome.
- Non-carnivorous leaves are produced and followed by carnivorous traps that capture as much prey as possible to store food in the rhizome, which grows quickly and produces new growth points.
- Profuse flowering occurs late in summer and seedlings develop that attain a reasonable size within a few seasons.
- As the plants get crowded out they start to produce only non-carnivorous leaves to capture the small amounts of light that get through the canopy of surrounding plants, and live off the stores of nutrients in their rhizomes.
- The plants exist in this semi-dormant state for up to 10 years or more until the next fire.

Having visited approximately 20 *C. follicularis* sites, it is safe to say that this is the most typical growth habit for this species.

Some colonies are not subjected to this dense bush regrowth and grow in open areas at all times. Two sites that exhibit these growing conditions are Coalmine Beach (Fig. 4 left), and a very unusual site at Northcliffe (Fig. 4 right), where the plants grow in a substrate that is almost pure course silica sand. Plants growing in these conditions attain very attractive coloration due to year round exposure to strong sunlight. In the case of the plants at Northcliffe, the pitchers are stunted due to the very harsh conditions. Tests in cultivation show that these plants attain normal dimensions in good conditions and with less light don't color up.

This article may well raise more questions than it answers, but it is hoped that it will add to the store of knowledge on this enigmatic species.

References:

Mann, P. 2005, Observations of *Cephalotus follicularis* and *Drosera binata* in Western Australia. Carnivorous Plant Newsletter 34(3): 68-70.

McPherson, S. 2009. Pitcher Plants of the Old World, vol. 2. Redfern Natural History Productions, Poole, England. pp. 680-681.

Lowrie, A. 1998. Carnivorous Plants of Australia, vol. 3. UWA Publishing, Western Australia. p. 128.

D'Amato, P. 2013. The Savage Garden. Ten Speed Press, New York. pp. 210-211

Slack, A. 1979. Carnivorous Plants, AlphaBooks, London. p. 89.

THE SUNDEW HYBRID *DROSERA* ×*BELEZIANA* FOUND ON LONG ISLAND, NEW YORK

MATTHEW M. KAELIN • Bellmore • New York • USA • mattfromquogue@aol.com

Long Island, New York is the largest and most populated island in the contiguous United States and was formed by glacial terminal moraines and outwash plains which created many unique ecosystems. Home to sixteen species of carnivorous plants, there are three sundew species that are native of which *Drosera filiformis* are quite unmistakable with their long, threadlike leaves that grow erect. The other two species, *D. rotundifolia* and *D. intermedia*, normally grow as rosettes and appear to be quite similar to one another, but can be differentiated by a few notable characteristics.

Drosera rotundifolia grow as low rosettes having nearly circular traps that are wider than they are tall with petioles that tend to be slightly flattened, creased at their edges and have varying degrees of bristles (Fig. 1). The crown (central rosette, which consists of developing leaves) is wide and hairy with bristles. *Drosera rotundifolia* are quite common in the northern latitudes throughout the world and are readily found on Long Island. They normally grow in live *Sphagnum* moss, peaty soil, or even sandy peat, all usually moist, but tend to not be exceedingly wet. They have been found on Long Island in *Sphagnum* bogs, on kettle hole pond shores, along consistently wet sandy trails, and even in the *Sphagnum* moss surrounding a fresh-water aquifer among the desert-like dunes of the Fire Island wilderness.

Drosera intermedia can be identified by their traps (Fig. 1). Appearing more spoon-like, they are taller and much narrower than the *D. rotundifolia* traps. The petioles are smooth, rounded, and tend to be long. The crown is smaller and narrower than *D. rotundifolia* and does not have as hairy of bristles. Some *D. intermedia* may form long stalks in response to seasonal flooding and can grow rather large. *Drosera intermedia* can be found growing in sandy soils that are very wet and may be partially under water, such as along kettle hole pond and vernal pond shores, in and around any ditches or puddles that are near the water table, and have even been found growing in a low, wet depression near the fresh water aquifer in the dunes of the Fire Island wilderness. They can also be

Figure 1: *Drosera rotundifolia* (left), *D.* ×*beleziana* (center), and *D. intermedia* (right) traps. The center photo was taken in the Wharton State Forest, New Jersey, courtesy of Jason Ksepka.

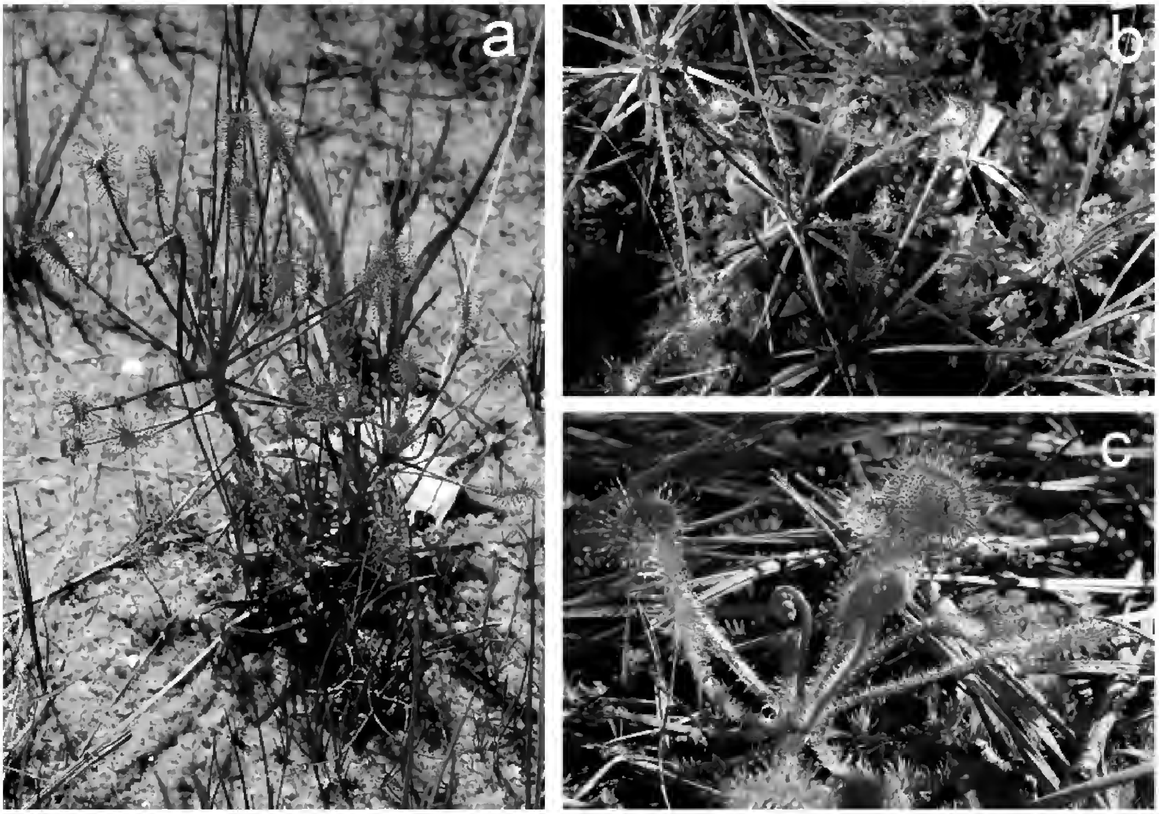


Figure 2: a) *Drosera intermedia* plant exhibiting characteristic smooth petioles and narrow crown with spoon-shaped traps growing in damp sand at edge of a vernal pond shore. Plant has grown into a stalk from earlier seasonal flooding which has subsided and is richly colored from exposure to full sun.
b) *Drosera* ×*beleziana* plant showing identifying characteristics such as long, rounded petioles with bristles and a wide, bristled crown. Traps are of intermediate shape between the two parents. Numerous examples of both parent species were found nearby.
c) *Drosera rotundifolia* plant exhibiting characteristic heavily bristled petioles and wide crown with round-shaped traps. Plant is growing in barely damp sand along a historic colonial wagon-trail in Pine Barren habitat which dips near the water table and contains the biodiversity of a coastal plains pond.

seen growing in more peaty soils, in the live moss of *Sphagnum* bogs, and in the muck surrounding those bogs.

The hybrid between *D. rotundifolia* and *D. intermedia* is known as *Drosera* ×*beleziana* (Fig. 1). I have recently discovered these hybrid plants on Long Island for the first time in New York. They were growing in the live *Sphagnum* moss hummocks in an Atlantic White Cedar forest on the edge of a pond which has moving water slowly flowing through it as part of the Peconic River watershed, and was once home to a commercial Cranberry bog. So far, I have only observed this hybrid growing in live *Sphagnum* moss in the wild, but cultivated specimens grow in a wet peat/sand mix quite well.

Drosera ×*beleziana* can grow noticeably large compared to either of the parents, but can be difficult to identify because the hybrid contains characteristics from both. Of the recent specimens found on Long Island, the discerning characteristics of some *D.* ×*beleziana* are the wide crown shape heavy with bristles and the hairy petioles that *D. rotundifolia* exhibit combined with the long and rounded petioles of *D. intermedia*. The trap shapes are intermediate between both parents and

in these examples, look more like *D. intermedia*. In other cases, *D. ×beleziana* can appear to be the opposite, with wider more *D. rotundifolia*-like traps combined with the smoother petioles and the smaller crown of *D. intermedia*. These traits seem to vary with the individual, but most visible features are a blending of the characteristics of each parent, not fully being one or the other. Any of these characteristics are less noticeable with young plants, being more easily identified in more mature and fully grown plants.

Drosera ×beleziana has not been commonly identified in the wild, perhaps because it takes careful observation to see the intermediate characteristics — or, perhaps, hybridization may be rare. The flowers of both of the parents have somewhat dissimilar shapes and sizes, although the differences are not all that extreme. The flowers open at similar times of the year and day, and it would be interesting to study the pollinators of each of these species. It is possible that the variability observed in the hybrids may depend on whether *D. rotundifolia* or *D. intermedia* is the pollen parent.

Drosera ×beleziana has been reported from France, England, Scandinavia, Massachusetts, the New Jersey Pine Barrens, and now the Long Island Pine Barrens. There is no reason this hybrid should not be more commonly found in areas where both parent species grow together other than the ease of them being overlooked, misidentified, or confused with either of the parents. Perhaps with more understanding of the characteristics, this hybrid will become more readily identified in the other areas of the world where both of the parent species coexist.

Further reading:

Schnell, D.E. 1976. Carnivorous Plants of the United States and Canada. J.F. Blair, Winston-Salem, NC.

McPherson, S., and Schnell, D. 2013. Field Guide to the Carnivorous Plants of the United States and Canada. Redfern Natural History Productions Ltd., Poole, UK.

http://www.carnivorousplants.org/cpn/articles/CPNv07n4p107_109.pdf

http://carnivorousplantsocietyblog.blogspot.com/2012/09/d-beleziana.html

http://www.biodiversitylibrary.org/item/22090#page/208/mode/1up

http://www.carnivorousplants.org/cp/DroseraHybrids.php

http://www.sarracenia.com/faq/faq5265.html

THE LIFE AND DEATH OF ARTHUR DOBBS

MATTHEW M. KAELIN • Bellmore • New York • USA • mattfromquogue@aol.com

Dark waters were churning beneath the vessel as we crossed the Cape Fear River on our way to visit the grave of old Arthur Dobbs.

For those of you who do not know about Arthur Dobbs (Fig. 1), he was the Colonial Governor of North Carolina from 1754 to 1765 and is the person who made the discovery of the Venus Flytrap around 1758. Born April 2nd, 1689 to Richard Dobbs and Mary Stewart Dobbs, he would inherit Castle Dobbs in Carrickfergus, Northern Ireland, which was founded by his ancestors who emigrated from Scotland in the 1500's. He married the young widow Anne Osburn Norbury on the 12th of May in 1719 and fathered three sons and a daughter. A highly-accomplished individual, he served as the Engineer-in-Chief and Surveyor-General of Ireland, High Sheriff of Antrim, and an elected member of the Irish Parliament. In his spare time, he was also an avid naturalist being the first person to recognize the pollination of flowers by bees authoring "Concerning Bees and their methods of Gathering Wax and Honey" for the Royal Society in 1750 as well as several articles on astronomy.

With a keen interest in the British Colonies of North America, Arthur Dobbs purchased 400,000 acres in North Carolina in 1745 and eventually would own 1,300,000 acres. Sadly, he lost his wife Anne after 28 years of marriage in 1747 and became so distraught from her death that he accomplished little over the following three years. He then decided to leave his estate in the care of his eldest son and set out for the New World when he gained the appointment by the British Crown to become the next Governor of North Carolina.

When not fulfilling his numerous official duties, Arthur Dobbs could frequently be seen in Brunswick following bees to chart their flight, recording the weather, and getting onto his hands and knees to investigate the new and unusual plants he had never seen back home in Ulster.

Then on his 70th birthday on April 2nd, 1759, he wrote a letter to English naturalist Peter Collinson, in which he states "I have taken a little plantation at the sound on the sea coast. We have a kind of a Catch Fly Sensitive which closes upon anything that touches it. It grows in the Latitude 34 but not in 35. I will try to save the seed here. Your most humble servant, Arthur Dobbs." He sent one of these unusual plants to John Bartram in England, who was Royal Botanist to King George III for the North American Colonies and who is also the person thought to have conjured the name "Tippitiwitchet" for the plant. Rumored to be of American Indian origin, it has been proven to not be as there is no such word in the Native American languages. In fact, it is thought to be a slang word used for the female genitalia. So here we see that the predominate characteristic that this group of men think

Figure 1: Arthur Dobbs. Photo courtesy of North Carolina Museum of History, with permission.

of when they see this new wonder of the botanical world, the likes never seen before is, in fact, the likeness of a woman's most personal anatomy.

Arthur Dobbs seemed to lose interest in our most famous carnivorous plant species, for in 1762 as a widower for 15 years and at the age of 73, he married Justina Davis, granddaughter of Governor James Moore of South Carolina, who at 15, was 58 years his junior. In a letter to John Bartram on 29 August 1762, Peter Collinson wrote: "It is now in vain to write to him for seeds or plants of Tipitiwitchet now He has gott one of his Own to play with." This would be appalling today and was, in fact, quite scandalous even in its time. In a particularly scathing attack perhaps guided more by politics, as Dobbs' age was actually five years younger than claimed, we hear the colorful statement: "Our old silenus of the envigorated age of seventy eight who still damns this province with his baneful influence grew stupidly enamored with Miss Davis a lovely lady of sprightly fifteen of a good family and some fortune." Although despite the wide age difference, it does appear that this was a warm, loving marriage. Especially seen in their writings addressed to their friends and families where they mentioned one another with such tender and dear manners.

Unfortunately, within just a few months after their marriage, Dobbs suffered a stroke which confined him to a wheelchair for the rest of his life. His young wife nursed him back to health and he eventually recovered enough to carry on with his official duties for a couple of more years until he decided to retire and return to Ireland with his beloved Justina. She was described to be quite excited about this, but only two weeks before they were to depart, Dobbs suffered a seizure and two days later, on 28 March 1765, Arthur Dobbs died in Justina's arms. He was buried on the grounds of St. Philip's (Fig. 2), the Anglican Church Dobbs sought to complete, far away from his family estate in Ireland and his first wife Anne.

Justina was described as being almost inconsolable from her loss, but being very eligible at 18 years old, beautiful and well-connected in high society, she found herself approached by many suitors. After her grieving had passed, she married an attorney and legislator from Halifax, the 26-year-old Abner Nash. She bore him three children before she died in 1773 at only 26 years old and was laid to rest in Halifax. Abner would later remarry and become Governor of North Carolina, where eventually he would be buried on his plantation in Pembroke near New Bern and so Justina was left buried alone, more than a hundred miles from either of her husbands, forever fated to rest in solitude.

As we cross the turbulent Cape Fear River and I contemplate this history, my mind wanders and begins to imagine a wistful tale where deep in the night, when the light of the moon shines through a heavy mist that hangs over the land, one can make out the figures of Arthur Dobbs and Justina Davis meandering on a romantic stroll through the meadows where flytraps grow, holding one another's hands and delightfully laughing as carefree and in love everlasting. Lost souls that they are, having

Figure 2: St. Philip's Church ruins and cemetery, Brunswick Town, North Carolina.

been buried alone and forgotten by all, they restlessly rise from their graves to rendezvous with one another for the time they had together on this earth was all too brief with their ages widely disparate. And now, they have all of eternity to love and frolic as their ageless entities are no longer bound by such worldly constraints.

My vision then darkens and turns to when the ghosts of Arthur and Justina would come across a person poaching flytraps from the wild, their graceful and ethereal figures would burst into a blazing fury of hellfire, their forms contorting into grotesque and burning skeletal demons that rush the poacher in a screaming tempest, ripping apart the victim's body to bits that rain down feeding the thousands of little mouths of the flytraps below, eagerly gaping to feast upon this flesh as the cascades of blood spill to saturate the soil while the remaining bones smolder to dust and blow away with gusts of the passing wind.

And now we finally make landfall, with the salt-sea to our backs, we set forth for the ruins of the Saint Philip's Church to pay homage to the final resting place of Arthur Dobbs.

Sources:

http://susan747.wordpress.com/2010/02/21/gov-arthur-dobbs-and-a-trip-to-ireland/

http://news.google.com/newspapers?nid=1734&dat=19770531&id=9nwcAAAAIBAJ&sjid=kVEEAAAAIBAJ&pg=5877,2853690

http://www.sarracenia.com/faq/faq2880.html

http://www.thepeerage.com/p38310.htm

Pinguicula primuliflora 'Rose'

Bob Ziemer • McKinleyville • California • USA • bob@carnivorousplants.org

Pinguicula primuliflora (Wood & Godfr.) is native to the Gulf Coastal Plain of southeastern United States. The pale purple flowers are solitary, spurred, 2-lobed, and trumpet-shaped (Fig 1a). This warm-temperate perennial butterwort is one of the carnivorous plants that is propagated for mass markets and can be found in most garden centers. It is easily grown by beginners and readily propagates by plantlets that form on the leaf margins.

Pinguicula primuliflora 'Rose' (Ban) is a variant or possibly hybrid that produces a beautiful double flower (Fig. 1 and Back Cover). Other than the unique flower, the plant looks identical to the typical *P. primuliflora*.

As described in the accompanying translation by Koji Kondo of an article that appeared in the October 2000 issue of The Journal of Insectivorous Plant Society, *P. primuliflora* 'Rose' was discovered in May 1995 by Mitsuaki Ban growing among his *P. primuliflora* plants.

The name 'Rose' suggests that the flower resembles that of a rose (*Rosa* spp.). The name was coined by Mr. Ban and has been in common use for many years. This magnificent cultivar has become widely distributed and is now grown throughout the world.

The double flower is infertile. Propagation must be by vegetative methods. Plantlets are easily and naturally produced by budding at the leaf margins.

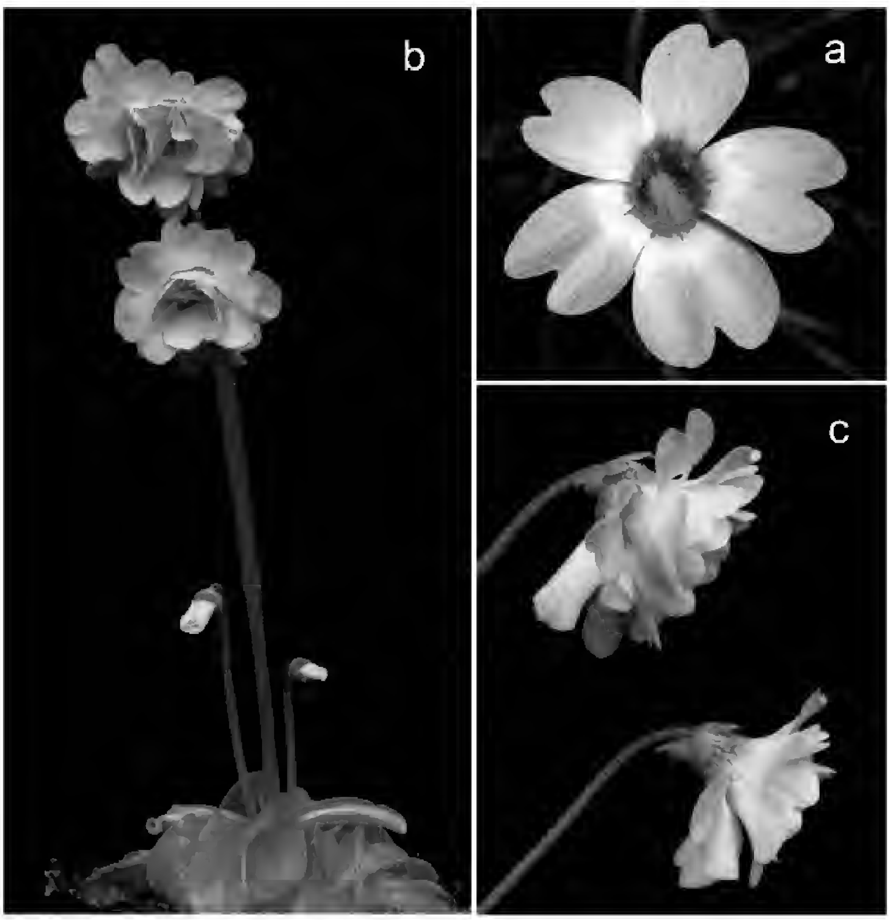


Figure 1: Comparison of (a) *Pinguicula primuliflora* flower with (b, c) *Pinguicula primuliflora* 'Rose'. Photo (a) by Barry Rice; (b and c) by Bob Ziemer.

Translated by Koji Kondo. Naoki Tanabe provided the original Japanese article from The Journal of Insectivorous Plant Society 51(4): 112, October 2000.

Double-flower of *P. primuliflora*

Mitsuaki Ban

This reports details of *P. primuliflora* "Rose" (double-flower) which I posted in the "Trade" page of the previous issue of Journal of IPS (J.IPS).

I found this variety among *P. primuliflora* plants blooming in my non-heated cold frame in May 1995. I consider this as a spontaneous mutant seedling. As I keep *P. primuliflora* plants in a non-heated cold frame throughout the year, the flowering season is mid-April, almost the same as the natural flowering season. Also many bees were flying around in the cold frame in the season. Therefore, insect pollinations seem to have happened and about 30% of the flowers produced seeds. I didn't intentionally collect the seeds, because this plant can be easily propagated asexually. However, unexpected seedlings came out from some pots and the double-flowered variety was one of them.

Cultivation of the variety is very easy, not different from the cultivation method for common *P. primuliflora.* Judging from the fact that all of about 60 plants had double flowers this year, this double-flower character seems to be stable. The number of petals varies depending on the plants' conditions; healthy plants have more than 5-layer flowers. The double-flower petals seem to derive from pistil, as only stamens remain when all petals are removed. I would like to give a name to this variety *P. primuliflora* "Rose," because the flower's appearance is reminiscent of a rose flower.

Pinguicula primuliflora 'Rose'. Scanned image from the October 2000 J.IPS 51(4) provided by Naoki Tanabe, JCPS Chairperson.

Butterworts of Section Isoloba are very often kept in heated cold frames in winter and such plants' flowering season shifts to February. Because of absence of polliniferous insects in the season, they hardly produce seeds unless pollinated artificially. As *P. primuliflora* propagates asexually through budbreak from leaf tips, its seeds are usually not purposely collected by the growers. Use of heated cold frames could be one of the reasons why *P. planifolia*, *P. caerulea* and so on have not become widely prevalent.

Actually, both my short report and my trade page posting were supposed to appear in the previous issue of J.IPS. However, Mr. Satoru Ishizaka, living in Seto City, also submitted a picture of his double-flowered *P. primuliflora* for trade posting and IPS, Japan asked me to rewrite my article after checking Ishizaka's pictures. While I was communicating with Mr. Ishizaka and checking his picture, I missed the deadline to submit the rewritten article. Thus only my trade page posting appeared in the No. 3 issue. When I asked Mr. Ishizaka about his double-flowered *P. primuliflora*, he explained that he ob-

tained his *P. primuliflora* from Mr. Masahiro Kondo and had been maintaining it for many years. His *P. primuliflora* plants were once about to die down but recovered later. He found a double-flowered plant among the recovered plants. As I knew that he also obtained my double-flowered lineage from an ex-IPS, Japan member, living in Agui Town, to whom I shared my double-flowered plant in 1995, I thought both lineages might be identical. However, Mr. Ishizaka told me that his double-flowered lineage was different from my lineage. Petals of his double-flowered plants are 2 layers or so, not more than 3 layers. Therefore, I name my lineage *P. primuliflora* "Rose" (Type Ban) to differentiate from Ishizaka's lineage. I have obtained Mr. Ishizaka's consent for this nomenclature.

New cultivars

Keywords: cultivar, *Sarracenia* 'Randy Rable', *Sarracenia* 'Laughing Wizard'

Sarracenia 'Randy Rable'

Submitted: 24 June 2014

This hybrid is of unknown ancestry but I suspect *Sarracenia minor* and perhaps *S. rubra* subsp. *gulfensis* to be in its heritage.

Maximum pitcher height is 35 cm but it may get a bit taller. The pitcher tubes are green in the lower part, widening gradually to 3 cm wide at the mouth. The peristome or lip is very narrow, V-shaped and spouted, turning deep red. The broad lid covers the mouth opening almost entirely. Veining intensifies in the upper part of the pitcher to a bronzy brick red, with greenish areoles on the upper back of the pitcher. The underside of the lid is predominantly red in its forward parts. The flower is small with yellow petals that have an orange blush (Fig. 1).

I am naming this plant after a dear friend who passed away much too early in life. Randy was a lover of plants and gardens and motion pictures, and I miss our conversations about these subjects very much. His sister, Charmaine, worked at California Carnivores for several years in the 1990's.

Sarracenia 'Randy Rable' must be reproduced vegetatively to preserve the characteristics of the cultivar.

—Peter D'Amato • California Carnivores • 2833 Old Gravenstein Hwy • Sebastopol, CA 95472 • califcarn@aol.com

Figure 1: *Sarracenia* 'Randy Rable'.

Submitted: 25 June 2014

Sarracenia 'Laughing Wizard' resulted from a batch of seed that I received about five years ago from an unknown grower. The seed parent was *S. alata* "Rayburn County" and the pollen parent was *S. flava* 'Claret'.

Early in the growing season, the pitcher is all red except for a yellow/green lid that has a distinctive pointed curl at its peak. There is a large neck between the lip and the base of the lid. As the year progresses, the lid develops a deep red color with heavy veins. The pitcher mouth is oval, which gives it the laughing appearance, and the throat gets very dark – making the pitcher look like it's wearing a pointy wizard hat (Fig. 2).

The main features of the plant are the deep red body of the pitcher, dark throat, dark oval lip which looks like it's laughing, and the heavily veined wizard hat shaped lid which curls up to a point.

Sarracenia 'Laughing Wizard' was named on 12 June 2014 due to the wizard hat appearance of the lid and the mouth shape of the pitcher lip that makes the plant look like it is laughing.

Sarracenia 'Laughing Wizard' must be reproduced vegetatively to preserve the characteristics of the cultivar.

—Matthew Hutley • 113 The Street • Black Notley • Braintree • Essex CM77 8LL • UK • hutleymatthew@gmail.com

Figure 2: *Sarracenia* 'Laughing Wizard'.